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Federal, state and tribal authorities advise caution on dangerous Klamath River algae

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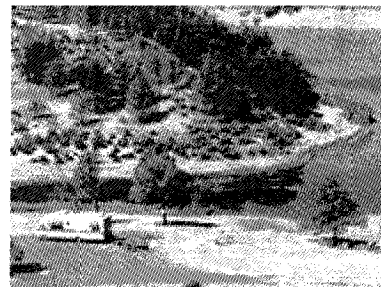
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SAN FRANCISCO – In response to the emergence of dangerous algal blooms in the Klamath River in California, the Karuk Tribe, the North Coast Regional Water Board and the U.S. Environmental Protection Agency are joining other local, state and federal agencies in warning residents and recreational users of the river to use caution when near such blooms.

"This algae produces toxins that pose a significant potential public health concern. We advise people to avoid all direct contact with Klamath River water while the bloom is occurring," said Alexis Strauss, Water Division director of the EPA's regional office in San Francisco.

Water samples taken over the past two months from Copco and Iron Gate Reservoirs – located on the Klamath near the Oregon border – have revealed high levels of the toxic blue-green alga *Microcystis aeruginosa*. Blooms of *Microcystis aeruginosa*, which often occur between June and September, can look like green, blue-green, white or brown foam, scum or mats floating on the water. They have been found as far as 125 miles downstream of the reservoirs.

The Klamath River is rich in nutrients that support the growth of the blue-green algae. Warm and calm surface water created by Iron Gate and Copco Reservoirs provide an ideal environment for the growth of large algal blooms. The extent of the blooms, and their toxicity, were not known until studies were conducted this year by the Karuk Tribe.



The Klamath River is a popular recreation area on the California-Oregon border.
(Photo credit: State Water Resources Control Board)



Water samples collected in Copco and Iron Gate reservoirs on the Klamath River have shown high levels of toxic blue-green algae.

"In August, we found levels of *Microcystis aeruginosa* as high as 46.8 million cells/ml along the shoreline and 8.9 millions cells/ml on the open water. These levels exceed the World Health Organization (WHO) standard for recreational use by 468 and 89 times, respectively," explained Susan Corum, the Water Resources Coordinator for the Karuk Tribe's Department of Natural Resources. "Microcystin toxin produced by the blooms in these locations was 1571.7 and 436.9 µg/L; exceeding the WHO Tolerable Daily Intake level by 217 and 60.3 times respectively. These levels are among the highest recorded in the United States."

According to California's Office of Environmental Health Hazard Assessment (OEHH), the U.S. EPA, the Karuk Tribe and Water Board, the *Microcystis aeruginosa* and resulting microcystin toxin pose a significant potential health threat to humans and animals exposed through direct ingestion of contaminated water or incidental ingestion during recreational water activities and bathing.

"The public needs to take the microcystin toxin in this algae seriously," said Catherine Kuhlman, Executive Officer of the North Coast Water Board. "The levels of algae and associated toxins measured in parts of the

river are high enough to pose health risks to anyone drinking or bathing in the water, particularly children and animals."

Studies of the possible health effects of exposure to *Microcystis aeruginosa* and its microcystin toxin in the Klamath's waters range from mild, non-life threatening skin conditions to permanent organ impairment and death depending upon exposure time and intensity.

Symptoms could include mild to severe eye irritation, allergic skin rash, mouth ulcers, fever, cold and flu-like symptoms, vomiting, diarrhea, kidney damage, liver damage or complete failure, and death.

Children and animals are at the greatest risk of adverse effects, due to their smaller body size and higher water ingestion rates.

As pets and other domestic animals could drink contaminated water, pets and livestock should be kept away from the water.

There are three main ways to be exposed to *Microcystis aeruginosa* and subsequent microcystin toxins in contaminated waters:

- direct contact to exposed skin or to the highly sensitive membranes of the ear, eye, nose and throat;
- accidental or intentional swallowing; and;
- inhalation of contaminated water aerosols.

A full-grown adult ingesting 3.4 ounces of contaminated water in a given day would be exposed to levels 28 times greater than the accepted World Health Organization's Tolerable Daily Intake value. This calculation is based on a single one-hour "swimming event" per day. More swimming events or activities of longer duration could result in greater exposure.

For an average-size child who is 3-years-old, ingesting slightly more than a measuring cup of contaminated water in any one "swimming event" would be the equivalent of 278 times the accepted WHO Tolerable Daily Intake value. As with adults, more swimming events or activities of longer duration could result in greater exposure.

Local, state, tribal and federal health and environmental agencies recommend that people not drink or cook with contaminated waters.

You should avoid or minimize contact with contaminated waters. It is best of stay out of the water near algal blooms and to keep pets away. If you do come in contact with the water, wash thoroughly with clean water. Avoid eating fish caught during an algal bloom. If you do, fishermen should clean the fish with fresh water and dispose of the innards away from the river or where animals could eat them; Avoid irrigation with contaminated water; Report dead or distressed wildlife along the shoreline to local, state or tribal authorities.

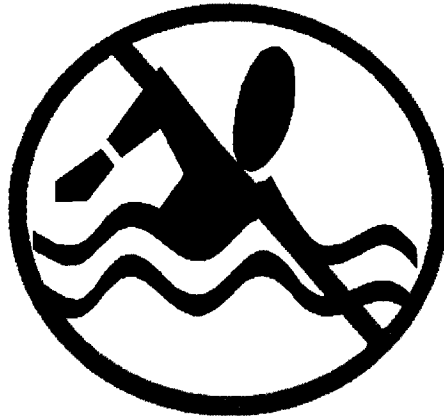


Algae blooms, such as this one at Mallard Cove on Copco Reservoir, produce toxins that could harm people and animals. (Photo credit: State Water Resources Control Board)

For more information, visit: The 1999 World Health Organization, Toxic Cyanobacteria in Water: A guide to their public health consequences, monitoring and management at: http://www.who.int/water_sanitation_health/resourcesquality/toxiccyanbact/en/ and, World Health Organization Guidelines for Drinking Water Quality, 3rd Edition at: http://www.who.int/water_sanitation_health/dwq/gdwq3/en/index.html

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HEALTH ADVISORY



AVOID WATER CONTACT IN IRON GATE AND COPCO RESERVOIRS

Due to high levels of blue-green algae
that can produce harmful toxins.

- Do not use this water for drinking or cooking.
- Do not consume fish livers or digestive organs,
and wash fillets with drinking water.

Children and pets are at greatest risk.

For more information contact:

**North Coast Regional Water Quality Control Board
(707) 576-2225**

water impairments and corresponding implementation strategies. Note that a state could pursue water quality trading under 4b, so long as it follows the principles described in the Agency's relevant guidance.

If the Agency determines that the controls are not, in fact, "requirements," or that they will not result in attainment of applicable water quality standards within a reasonable time, then EPA may disapprove the state's failure to include the segment at issue on the section 303(d) list (i.e., Category 5) and add the segment to the list. In subsequent list submissions, EPA may determine that a segment that has been placed into Category 4b must go back into Category 5, if the circumstances have changed such that the state can no longer support its original 4b demonstration.

b. What constitutes acceptable "pollution control requirements" to support Category 4b alternatives?

Because of the case-specific nature of water quality impairments and controls designed to address such impairments, EPA cannot identify classes of controls that will always be adequate to support a conclusion that a segment is not required to be included in Category 5. In evaluating whether a particular set of pollution controls are in fact "requirements" as specified in EPA's regulation, the Agency will consider a number of factors including: (1) authority (local, state, federal) under which the controls are required and will be implemented with respect to sources contributing to the water quality impairment (examples may include: self-executing state or local regulations, permits, and contracts and grant/funding agreements that require implementation of necessary controls), (2) existing commitments made by the sources to implementation of the controls (including an analysis of the amount of actual implementation that has already occurred), (3) the availability of dedicated funding for the implementation of the controls, and (4) other relevant factors as determined by EPA depending on case-specific circumstances.

Since the overriding objective of the 4b alternative is to promote implementation activities designed to achieve water quality standards in a reasonable period of time, for all of the factors listed above, EPA will evaluate each 4b alternative on a case-by-case basis, including in particular the existence of identifiable consequences for the failure to implement the proposed pollution controls. Depending on the specific situation, "other pollution control requirements" may be requirements other than those based on statutory or regulatory provisions, as long as some combination of the factors listed above are present and will lead to achievement of WQSs within a reasonable period of time. For example, established plans of government agencies that require for attainment of WQS with a reasonable period of time may qualify even when their components include incentive-based actions by private parties. States may also choose to rely on controls that have already been implemented where there is sufficient certainty that implementation will continue until WQS are achieved and will not be reversed. Because the controls are already in place and achieving progress, EPA may consider such controls to be requirements even if their implementation did not occur pursuant to binding legal authority.

c. What constitutes a reasonable period of time for purposes of 4b?

EPA expects that segments impaired by a pollutant but not listed under section 303(d) based on the implementation of existing control requirements will attain WQSs within a reasonable period of time. What constitutes a "reasonable time" will vary depending on factors such as the initial severity of the impairment, the cause of the impairment (e.g., point source discharges, in place sediment fluxes, atmospheric deposition, nonpoint source runoff), riparian condition, channel condition, the nature and behavior of the specific pollutant (e.g., conservative, reactive), the size and complexity of the segment (a

designated use, even though ambient water column concentrations of pollutants do not indicate an exceedance, EPA recommends states translate the applicable narrative criteria on a site-specific basis or adopt site specific numeric criteria to account for higher than expected exposures from contaminated fish or shellfish tissue and protect designated uses.

Applicable shellfish growing area classifications should be used as part of determinations of attainment of water quality standards and listing of impaired segments. Shellfish growing area classifications are developed by the National Shellfish Sanitation Program (NSSP) using water column and tissue data (where available), and information from sanitary surveys of the contributing watershed, to protect public health. The states review these NSSP classifications every three years. There are certain NSSP classifications and data that do not necessarily indicate WQS violation. These include: "Prohibited" classifications set as a precautionary measure due to the proximity of wastewater treatment discharges, or absence of a required sanitary survey; shellfish tissue pathogen data (which can fluctuate based on short-term conditions not representative of general water quality); or short-term actions to place growing areas in the closed status.

When deciding whether to identify a segment as impaired, states need to determine whether there are impairments of designated uses and narrative criteria, as well as the numeric criteria. Although the CWA does not explicitly direct the use of fish and shellfish consumption advisories or NSSP classifications to determine attainment of water quality standards, states are required to consider all existing and readily available data and information to identify impaired segments on their section 303(d) lists. For purposes of determining whether a segment is impaired and should be included on a section 303(d) list, EPA considers a fish or shellfish consumption advisory, a NSSP classification, and the supporting data, to be existing and readily available data and information that demonstrates non-attainment of a section 101(a) "fishable" use when:

- the advisory is based on fish and shellfish tissue data,
- a lower than "Approved" NSSP classification is based on water column and shellfish tissue data (and this is not a precautionary "Prohibited" classification or the state water quality standard does not identify lower than "Approved" as attainment of the standard),
- the data are collected from the specific segment in question, and
- the risk assessment parameters (e.g., toxicity, risk level, exposure duration and consumption rate) of the advisory or classification are cumulatively equal to or less protective than those in the state's water quality standards.

This applies to all pollutants that constitute potential risks to human health, regardless of the source of the pollutant. However, for fish/shellfish advisories for "dioxin and dioxin-like compounds", due to unique risk characterization issues, listing decisions should be made on a case-by-case basis.

EPA acknowledges that in some cases, fish and shellfish consumption advisories may not demonstrate that a section 101(a) "fishable" use is not being attained in an individual segment. For example, a state may have issued a statewide or regional warning regarding fish tissue contaminated with a bioaccumulative pollutant, based on data from a subset of segments. A state may use a higher fish consumption value in determining the need for an advisory compared to the value used in establishing water quality criteria for the protection of human health. As noted above, a state may also classify shellfish growing areas "Prohibited" as a precautionary measure due to the proximity of wastewater treatment discharges or where a required sanitary survey has not been conducted. In such instances, these

9. *What additional information is needed for segments in Category 5?*

Identification of Pollutants

Section 130.7(b)(4) requires states to identify, for each segment included on the section 303(d) list (Category 5), the "pollutants causing or expected to cause violations of the applicable water quality standards." For the 2006 listing cycle, segments identified as impaired or threatened based on biological criteria should be included in Category 5 unless the state demonstrates that a pollutant is not causing the impairment, or inclusion in Categories 4a or 4b is warranted. States must identify all pollutants that are known to be causing the impairment of a segment.

Prioritization and TMDL Schedule

Section 303(d)(1) requires states to "establish a priority ranking" for the segments it identifies on the list, taking into account the severity of the pollution and the uses to be made of such segments, and to establish TMDLs "in accordance with the priority ranking." Consistent with section 130.7(b)(4) each state shall also submit biennially a priority ranking including waters targeted for TMDL development in the next two years. Each listed pollutant-segment combination (i.e., those in Category 5) must receive a clear priority ranking, which EPA recommends be either in the form of a scheduled TMDL completion date or a ranking such as high, medium, or low. States have considerable flexibility in deciding how best to apply these factors in prioritizing their list of waters needing TMDLs. For example, a waterbody with a severe water quality problem may be given a high priority for TMDL development in light of the severity of the concern. Conversely, a severe water quality problem may require complex analysis before developing a TMDL, and the state may therefore choose to give it a lower priority to allow time to collect necessary information and complete the analysis. Thus, the most severe water quality problems or the most toxic pollutants need not always be given the highest priority for TMDL development, if circumstances warrant a lower priority. EPA will review the priority ranking but will not take action to approve or disapprove it.

Federal regulations provide that "schedules for submissions of TMDLs shall be determined by the Regional Administrator and the State" (40 CFR 130.7(d)(1)). Factors such as the state's use of a rotating basin approach or commitments specified in court orders or consent decrees may be considered when states develop priorities and schedules. EPA recommends that states develop a schedule for establishing TMDLs as expeditiously as practicable and that the schedule (1) identifies which TMDLs will be established in each year of the upcoming integrated reporting cycle and (2) estimates the approximate number of TMDLs to be established for each year thereafter. EPA encourages the states to ensure that the schedule provides that all TMDLs for every pollutant-segment combination listed on previous section 303(d) lists be established in a time frame that is no longer than 8 to 13 years from the time the pollutant-segment combination is first identified in Category 5. EPA will not take any action on the schedule. The schedule is intended to help the public and EPA to understand the state's priorities and assist in work planning.

In developing their schedules, states will need to decide which TMDLs are higher priority than others. States need not specifically identify each TMDL as high, medium or low priority. Instead, the schedule itself can reflect the state's priority ranking. The CWA does not prescribe a particular method of expressing a priority ranking, and EPA believes a TMDL schedule is a reasonable, efficient way to demonstrate priority ranking. In some circumstances, the order in which TMDLs are established might be

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When States choose to support their assessments with the collection of supplemental data, Category 3 provides States with the flexibility to monitor these waters in a manner consistent with their overall monitoring strategy and schedule.

Category 3 responds to one of the recommendations in the 2001 National Research Council's (NRC) report, *Assessing the TMDL Approach to Water Quality Management* (2001) that EPA and States identify waters where information is not sufficient to determine a water's status, and thus identify waters where additional data and information is necessary prior to making an assessment determination.

E. Which waters belong in Category 4?

Waters belong in Category 4 if one or more designated uses are impaired or threatened but establishment of a TMDL is not required. States may place an impaired or threatened water that does not require a TMDL in one of the following three subcategories: a TMDL has been completed for the water-pollutant combination (Category 4A), other required control measures are expected to result in the attainment of WQSs in a reasonable period of time (Category 4B); and the impairment or threat is not caused by a pollutant (Category 4C).

1. Which waters belong in Category 4A?

Waters should only be placed in Category 4A when all TMDLs needed to result in attainment of all applicable WQSs have been approved or established by EPA. Once the TMDLs have been approved or established, the State should implement the TMDL as soon as practicable. Additionally, EPA encourages States to provide monitoring schedules for these waters to ensure that sufficient data are obtained to document progress of the implementation actions toward the attainment of WQSs, and that progress is reasonably consistent with the projected time of attainment included in the TMDL.

2. Which waters belong in Category 4B?

Current regulations do not require TMDLs for all waters. Some waters may be excluded from Category 5, and placed into Category 4B. In order to meet the requirements to place these waters into Category 4B, the State must demonstrate that "other pollution control requirements (e.g., best management practices) required by local, State or Federal authority" (see 40 CFR 130.7(b)(1)(iii)) are expected to address all water-pollutant combinations and attain all WQSs in a reasonable period of time. EPA expects that States will provide adequate documentation that the required¹ control

¹"Although TMDLs play an important informational role in the CWA's regulatory scheme, they are not regulations, and they do not impose legal obligations or prohibitions on polluters. Rather, TMDLs identify the reductions in the overall loading of a pollutant in a designated segment of substandard water that are necessary to bring that segment into compliance with a water quality standard, thereby allowing 'the states to proceed from the identification of waters requiring additional planning to the required plans.' Pet. App. 9a, 68a-69a. 'TMDLs serve as a link in an implementation chain that includes federally-regulated point source controls, state or local plans for point and non-point source pollution reduction, and assessment of the impact of such measures on water quality.' *Id.* at 9a. When a TMDL identifies

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mechanisms will address all major pollutant sources and establish a clear link between the control mechanisms and WQSSs.

3. *What are EPA's expectations for including waters impaired by point sources in Category 4B?*

A decision to list a water in Category 4B using §130.7 (b)(1)(i) must be supported by the issuance of technology-based effluent limitations *required* by Sections 301(b), 306, 307 or other sections of the CWA. A decision to list in Category 4B using §130.7 (b)(1)(ii) must be supported by the issuance of more stringent effluent limitations required by either Federal, State or local authority. EPA expects that the State will provide a rationale for why they believe that these effluent limits will achieve WQSSs within a reasonable period of time.

4. *What are EPA's expectations for including waters impaired by nonpoint sources in Category 4B?*

Placement of waters in Category 4B based on §130.7 (b)(iii) must be supported by the existence of "other pollution control requirements (e.g., best management practices) required by local, State, or federal authority" that are stringent enough to implement WQSSs. EPA expects that the State will demonstrate that these control requirements will achieve WQSSs within a reasonable period of time. States should provide the following information to support including a water in Category 4B:

- identification of the controls to be relied upon (for example, best management practices, air emission controls, sediment dredging, etc.);
- authority (local, state, federal) under which the controls are required and will be implemented with respect to the sources contributing to the water quality impairment (for example, self-executing State or local regulations, permits, or contracts that require implementation of the necessary controls);
- document how the control measures are generally applicable to the impairment in question and can reasonably be expected to reduce pollutant loadings and ultimately attain WQSSs when fully implemented. Generally, sufficient documentation will;

necessary reductions in pollutant loading from point sources, such reductions are achieved through restrictions set out in the NPDES permit or state permit for each point source. 33 U.S.C. 1311(a), 1362(12) and (14); 40 C.F.R. 122.44(d)(1)(vii)(B). But when a TMDL identifies necessary reductions in pollutant loadings from nonpoint sources, such reductions may be implemented only under state law, because the CWA does not have a permit program for, or otherwise regulate pollutant loadings from, nonpoint sources. See *NRDC v. EPA*, 915 F.2d 1314, 1316 (9th Cir. 1990). EPA has no authority to enforce TMDL pollutant-loading reductions against nonpoint sources or to require a State to do so. EPA may, however, disburse funds to the States to assist their implementation of nonpoint source management programs, including the development of best management practices to control non-point source pollution. See 33 U.S.C. 1329(h); *NRDC*, 915 F.2d at 1318." (*Guido A. Pronsolino, et. al., vs. EPA*, 9th Circuit Court of Appeals, On Petition for a Writ of Certiorari, No. 02-1186, in the Supreme Court of the United States. (2003))

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A water is considered impaired when one or more designated uses are not attained. Where more than one pollutant is causing the impairment, the water should remain in Category 5 until all pollutants are addressed in a completed/EPA-approved TMDL or by one of the delisting factors mentioned in the answer to question 2.a. below in this section.

1. *Is Category 5 of the Integrated Report for 2004 a new Section 303(d) list, and must the State account for all waters previously listed as needing a TMDL in the 2002 list?*

The Section 303(d) list once approved (or, if necessary, established by EPA following disapproval of a State's list) is a new list that replaces the previous list. The time frame for establishing TMDLs for individual water/ pollutant combination should be 8 to 13 years from the date of the original water/pollutant combination listing. For example, a water/pollutant combination originally included on the 1998 Section 303(d) list, and still identified on the 2004 submission as requiring a TMDL, should be addressed by 2011.

The fact that a water was previously included in Category 5 is not, by itself, positive evidence that it must remain in Category 5 until a TMDL is established. Waters should generally remain in Category 5 until a TMDL is established unless there is reason to believe that conditions that led to the initial listing have changed (WQSs are attained, actions justifying inclusion in Category 4, etc.), or that the basis for the initial listing was in error. In any of these circumstances where a water's status might change, all existing and readily available data and information should be considered, and the most current methodology applied to determine the water's most appropriate placement into one of the five categories.

EPA may request, as discussed below, that the State demonstrate "good cause" for not including previously listed segments in Category 5 (40 CFR 130.7(b)(6)(iv)). EPA may request this demonstration if the State does not develop a credible methodology (consistent with the State's WQSs, relevant sections of CALM, and this guidance), or does not apply the methodology consistently, especially where the "delisting" of an impaired water on a previous list is not supported by the application of the State's methodology.

2. *What do States need to consider regarding "Good Cause" delisting?*

- a. *What may constitute good cause for not including waters that were previously included in the current Category 5 (the Section 303(d) List)?*

If EPA requests "good cause" for not including on the 2004 submission waters that had previously been identified as impaired, the State must provide the reasons why the water has not been placed in Category 5. Consistent with 40 CFR 130.7(b) "good cause" for not including waters in Category 5 may be based on:

- The assessment and interpretation of more recent or more accurate data demonstrate that the applicable WQS(s) is being met.
- The results of more sophisticated water quality modeling demonstrate that the applicable WQS(s) is being met.

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States may revise their WQSs to address changes resulting from Use Attainability Analyses (40 CFR 131.10), development of a site-specific criterion, or updated science.

A decision not to list because a WQS is in the process of being revised would be inconsistent with the regulations cited above and the CWA, which require a State to identify "those waters within its boundaries" where controls "are not stringent enough to implement *any water quality standard applicable to such waters*" (Section 303(d)(1)(A) of the CWA, emphasis added). Therefore, States must include on their Section 303(d) lists waters that do not meet an applicable WQS at the time of listing, even if the standard is in the process of being revised to be less stringent, until such time as EPA approves the revised standard. If EPA approves a revised standard in the future, the water may be removed from the Section 303(d) list at that time provided the water does not meet the listing requirements with respect to the new standard (40 CFR 130.7(b)(3)). States have the discretion to assign a low priority for establishing a TMDL to those waters where there is probability that they may be removed from the list in the near future. States should be aware that a TMDL should be developed to meet the existing WQS, not a temporary variance that is less stringent than the existing WQS.

7. *What Additional Information is needed for waters in Category 5?*

a. *Identification of Pollutants*

Section 130.7(b)(4) requires States to identify, for each Section 303(d) list (Category 5 waters) submitted to EPA, the "pollutants causing or expected to cause violations of the applicable water quality standards." For the 2004 listing cycle, waters identified as impaired or threatened relative to biological criteria should be included in Category 5 unless it is known that a pollutant is not causing the impairment. States should identify all pollutants that are known to be causing the impairment of a water.

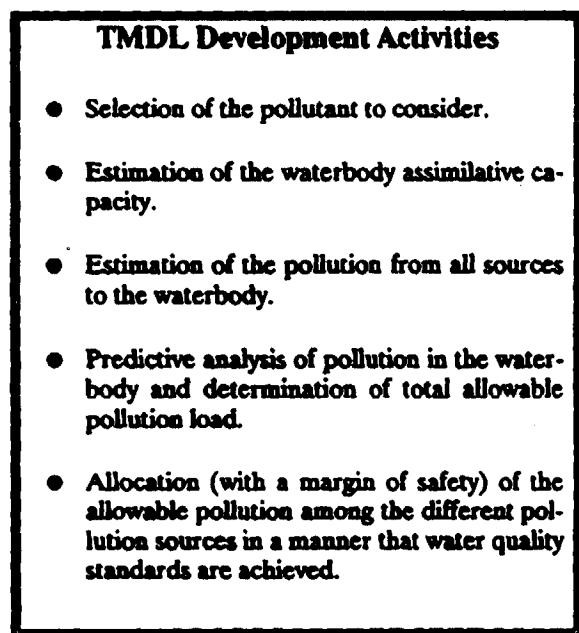
b. *Prioritization and TMDL Schedule*

Section 303(d) requires States to "establish a priority ranking" for the waters it identifies on the list, taking into account the severity of the pollution and the uses to be made of such waters, and to establish TMDLs "in accordance with the priority ranking." Federal regulations provide that "schedules for submissions of TMDLs shall be determined by the Regional Administrator and the State" (40 CFR 130.7(d)(1)). Other reasonable factors such as the State's use of a rotating basin approach or commitments specified in court orders or consent decrees may also be considered when States develop priorities and schedules. To implement this provision, EPA recommends that States develop a schedule for establishing TMDLs as expeditiously as practicable and that (1) identifies which TMDLs will be established in each year of the upcoming Integrated Reporting cycle and (2) the approximate number of TMDLs to be established for each year thereafter. EPA encourages the States to ensure that the schedule provides that all TMDLs for waters listed on previous Section 303(d) lists be established within 8 to 13 years. In addition, EPA suggests that newly identified Category 5 waters have a TMDL developed no later than 13 years after the water is first identified in Category 5. EPA will not be taking any action on either of these schedules. The schedules are

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example, the activity might be urban development for which effective controls can be implemented to reduce sediment loading to the impacted waterbody.

The TMDL process distributes portions of the waterbody's assimilative capacity to various pollution sources – including natural background sources and a margin of safety – so that the waterbody achieves its water quality standards. The analyst may use predictive modeling procedures to evaluate alternative pollution allocation schemes in the same waterbody. By optimizing alternative point and nonpoint source control strategies, the cost effectiveness and pollution reduction benefits of allocation tradeoffs may be evaluated (see Appendix D). The approach normally used to develop a TMDL for a particular waterbody or watershed consists of five activities (see box).



In developing a TMDL it is important to keep in mind certain constraints on the WLA portion that are imposed by antibacksliding regulatory provisions. The WLA will normally result in new or more stringent water

quality-based limits than those contained in a previously issued permit. In a limited number of cases, however, it is conceivable that less stringent water quality-based limits could result. In these cases, permit limits must conform to the antibacksliding provisions contained in section 402(o) of the CWA.

Selection of Approach

Figure 2 illustrates the critical decisions and the appropriate steps in the TMDL process for developing load allocations and implementing and evaluating control actions. In some cases, as illustrated by the left side of the diagram, TMDL development can be straight-forward and relatively simple. In other cases, as depicted by the right side of the diagram, a phased approach may be more appropriate. Regardless of which path is followed, the allocation of loads and establishment of control actions should ensure that all water quality-limited waters will meet their standards.

Once a waterbody is selected for action, an analyst must decide if the available data and information about the sources, fate, and transport of the pollutant to be controlled is adequate. The level of effort and scientific knowledge needed to acquire adequate data and perform meaningful predictive analyses is often a function of the pollutant source, pollutant characteristics, and the geographical scale of the pollution problem. As described in Chapter 2, modeling the fate and transport of conventional pollutants (e.g. biochemical oxygen demand) and point source contributions is better developed than modeling for non-traditional pollution problems. For certain non-traditional problems, if there are not adequate data and predictive tools to characterize and analyze the pollution problem with a known level of uncertainty, a phased approach may be necessary.

The phased approach is required when the TMDL involves both point and nonpoint